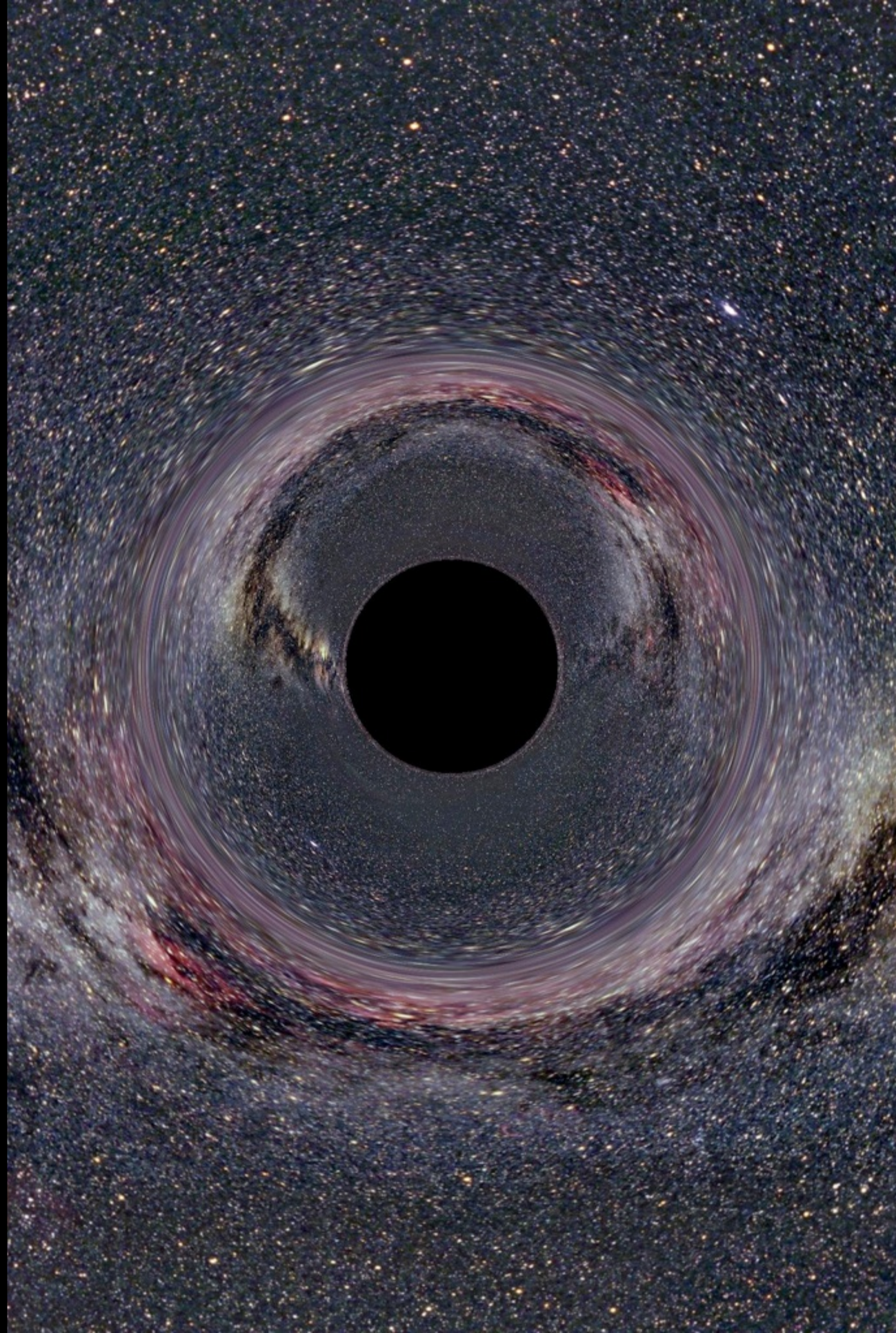
PDF version (animations missing)

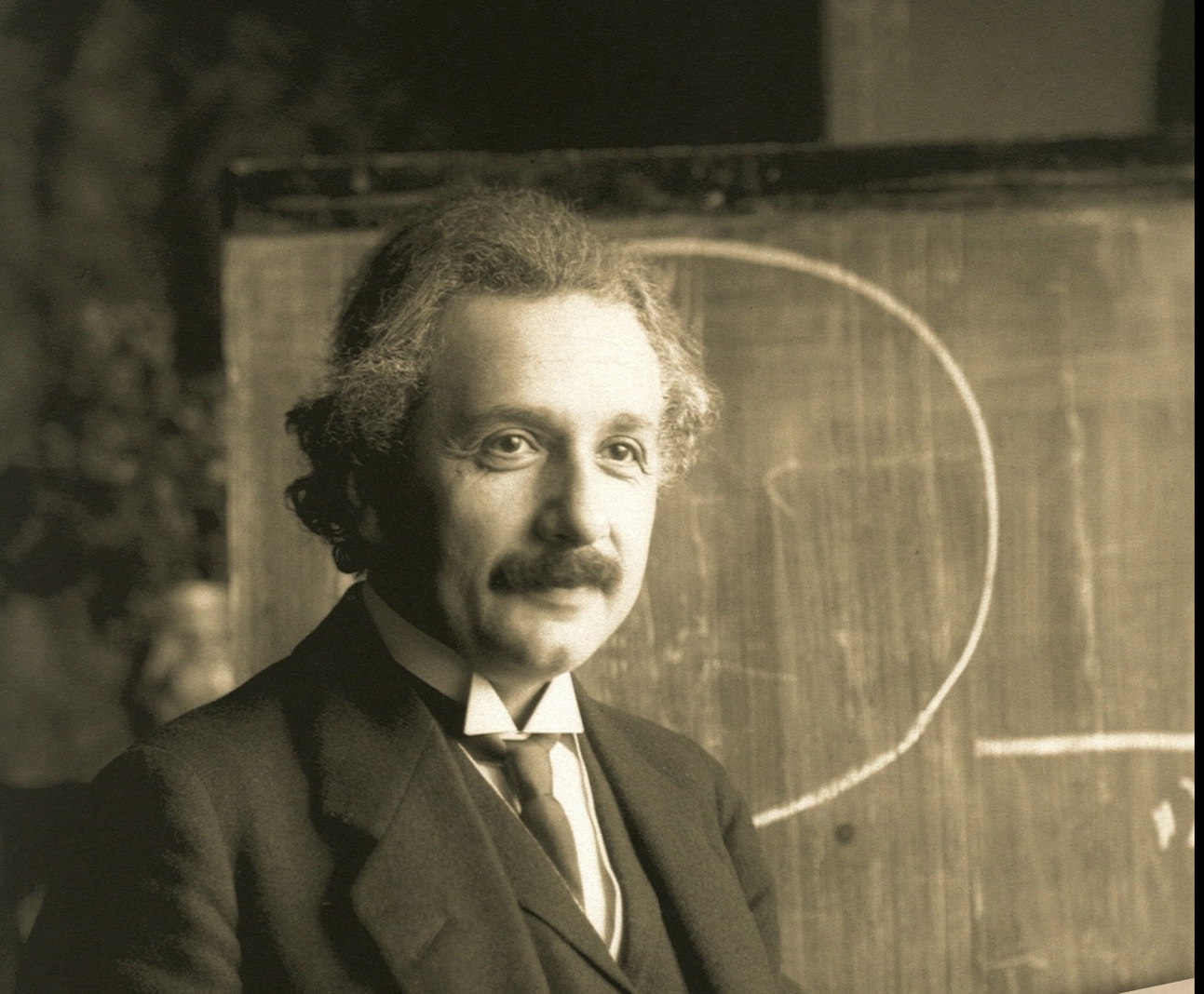
CAN BLACK HOLES SHINE?

MICHAEL COWLEY

TIMELINE OF BLACK HOLES

- 1915: Einstein's Theory of General Relativity
- 1919: Eddington's solar eclipse experiment
- 1967: Wheeler coins the term "black hole"
- 1970s: Hawking advances our understanding of black holes
- 2002: The Milky Way's lurking monster
- Today: What do we know and how do we find them?





Sitzung der physikalisch-mathematischen Klasse vom 25. November 1915

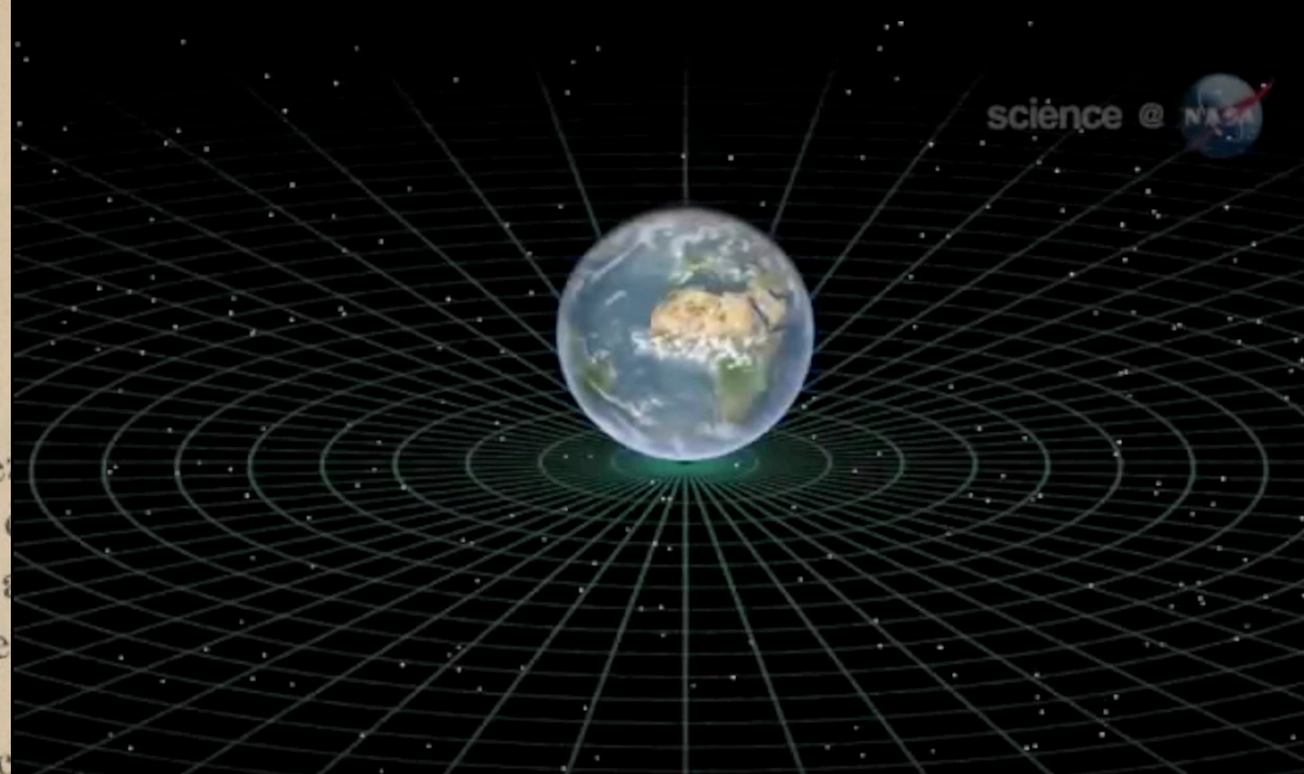
Die Feldgleichungen der Gravitation.

Von A. Einstein.

In zwei vor kurzem erschienenen Mitteilungen[1] habe ich ge
man zu Feldgleichungen der Gravitation gelangen kann, die
der Relativität entsprechen, d. h. die in ihrer
tionen der Raumzeitvariabeln ge

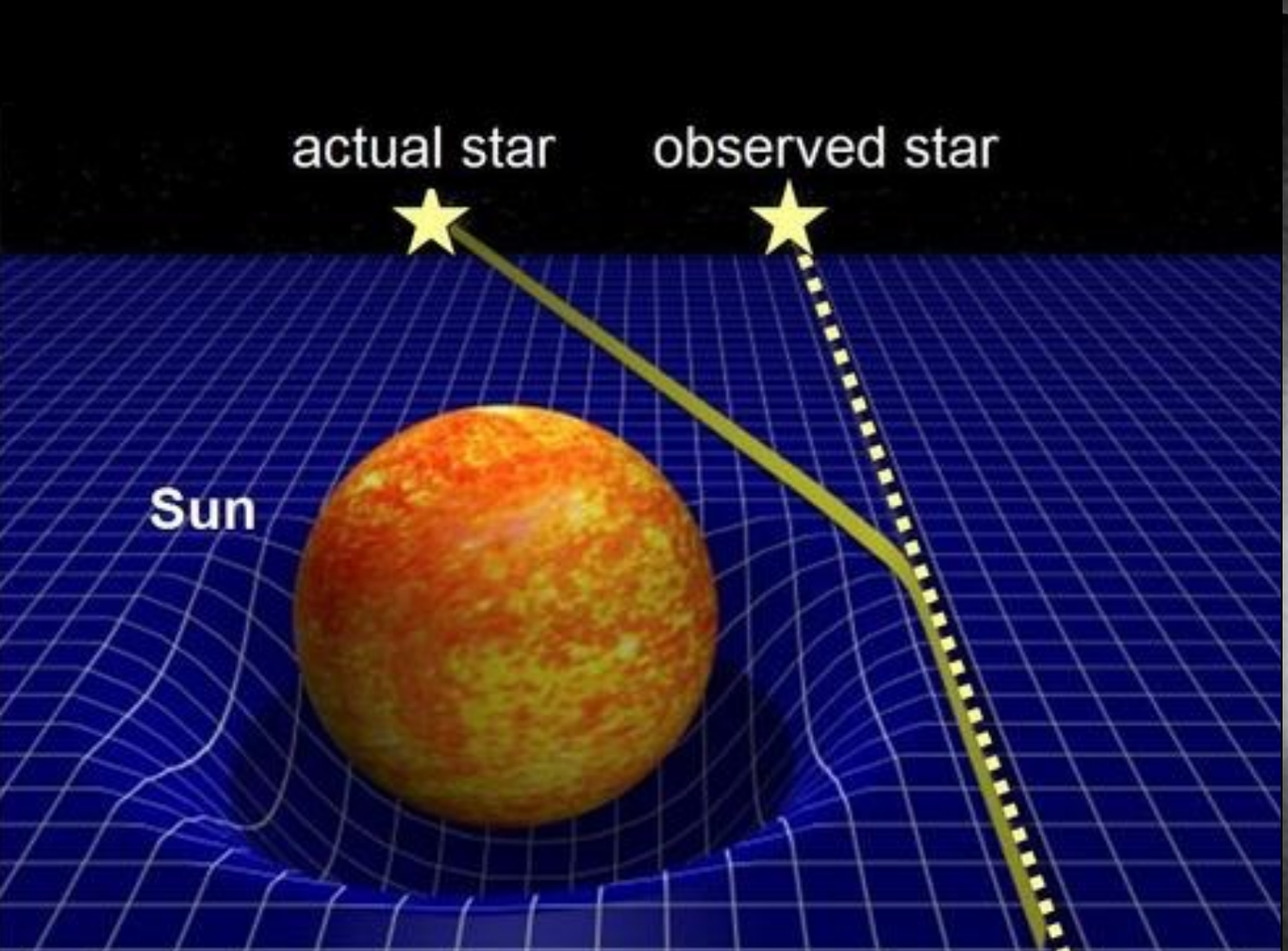
1915: Albert Einstein's General Relativity

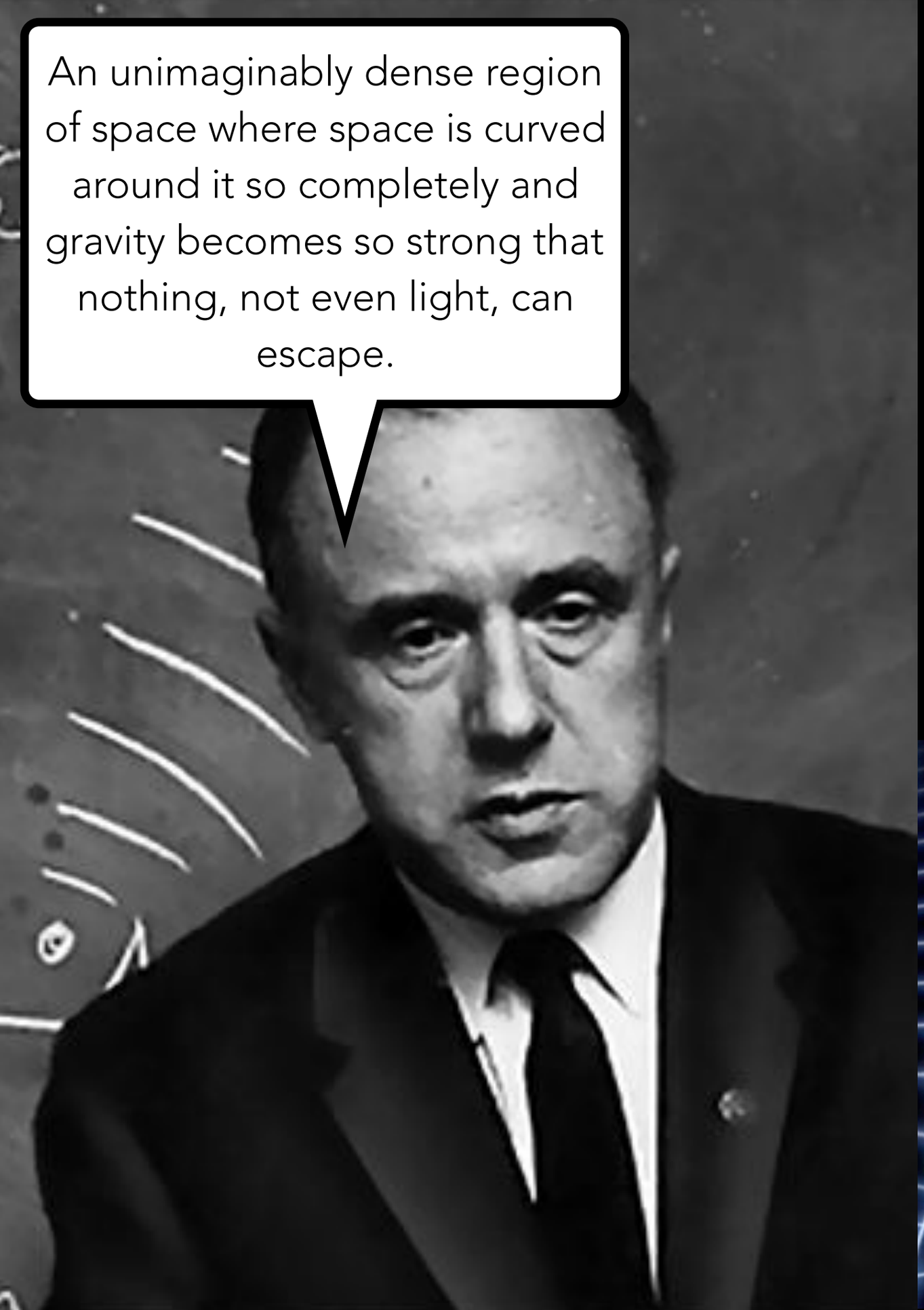
Albert Einstein's general theory of relativity describes the interaction of gravity as a result of space being curved by massive objects



1919: Sir Arthur Eddington's Solar Eclipse Experiment

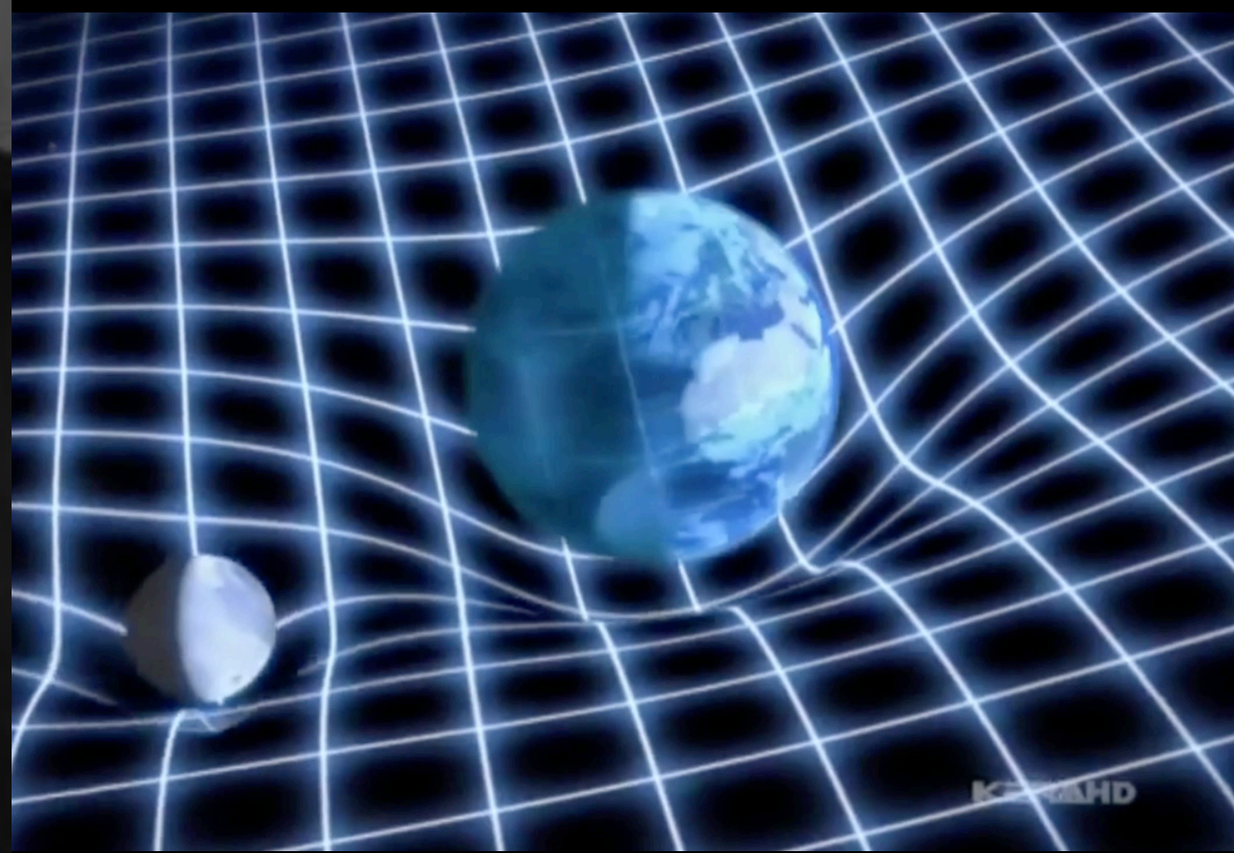
Eddington photographed positions of stars near the Sun to test Albert Einstein's prediction of the bending of light around massive objects from his general theory of relativity





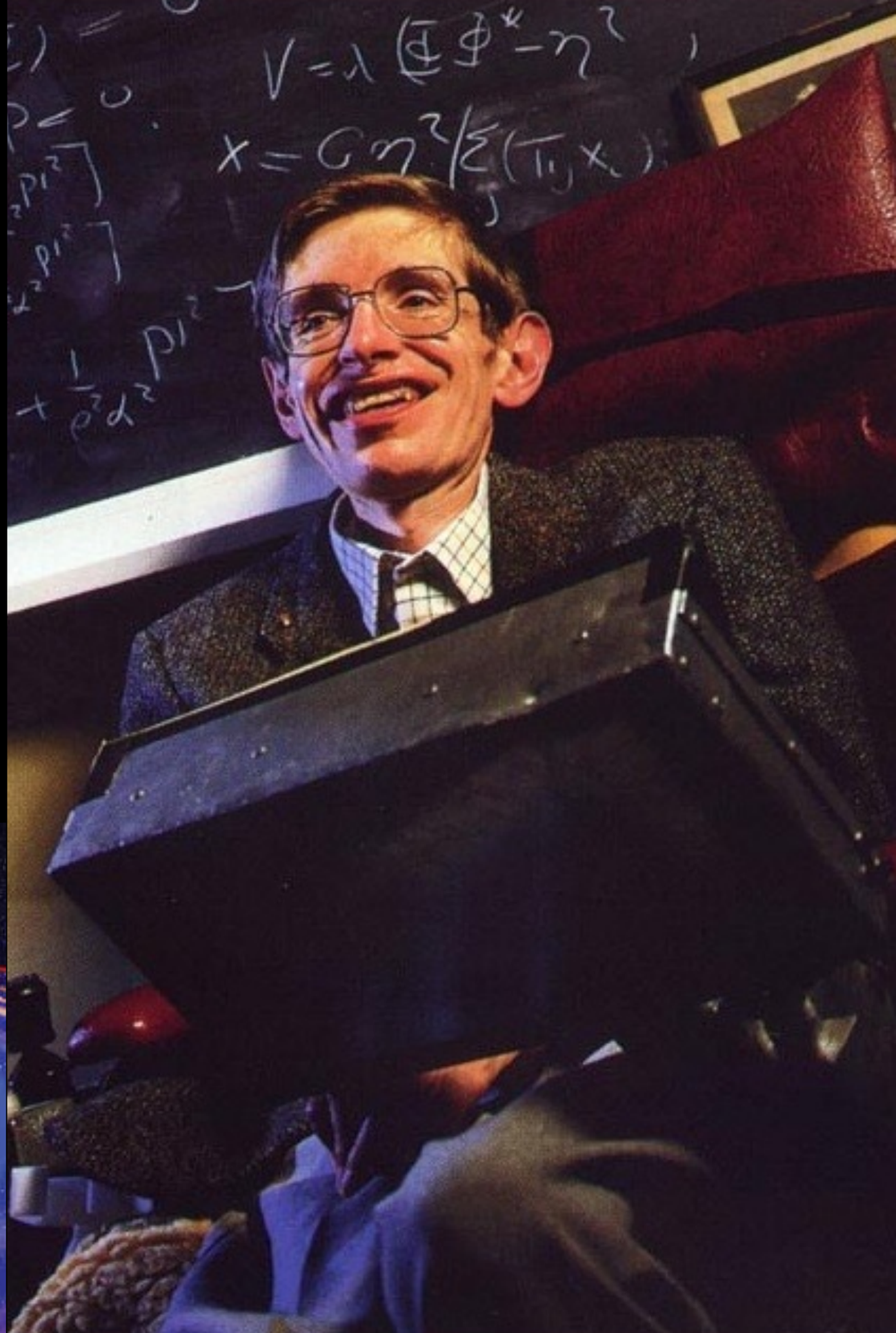
1964: John Wheeler coins the term “black hole”

American theoretical physicist, John Wheeler helps popularise the study of general relativity in the mainstream of theoretical physics, and coins the term “black holes”

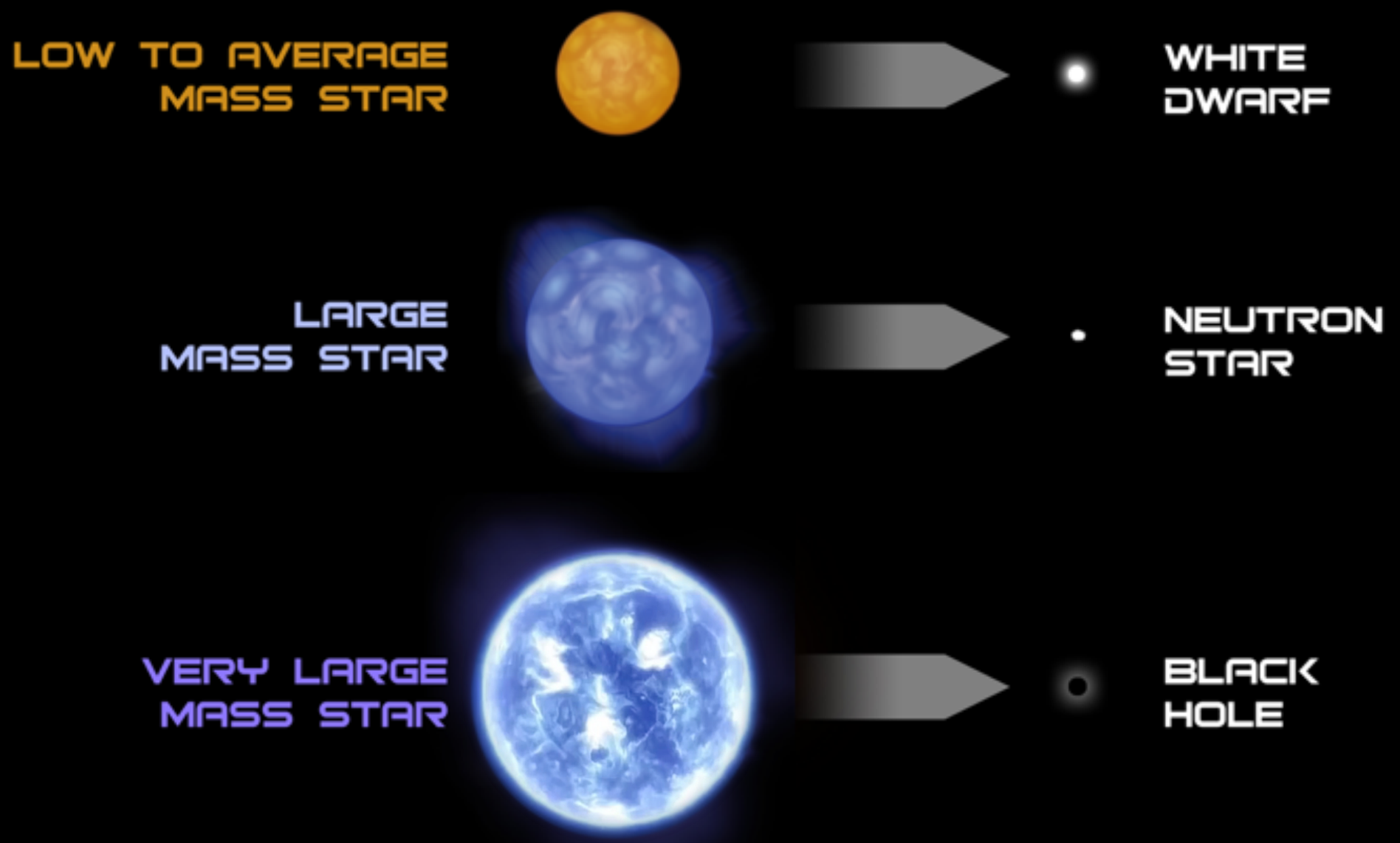


1970s: Stephen Hawking Advances our Understanding of Black Holes

In 1968, Stephen Hawking joins the Institute of Astronomy in Cambridge and begins to apply the laws of thermodynamics and quantum mechanics to black holes



BIRTH OF A BLACK HOLE



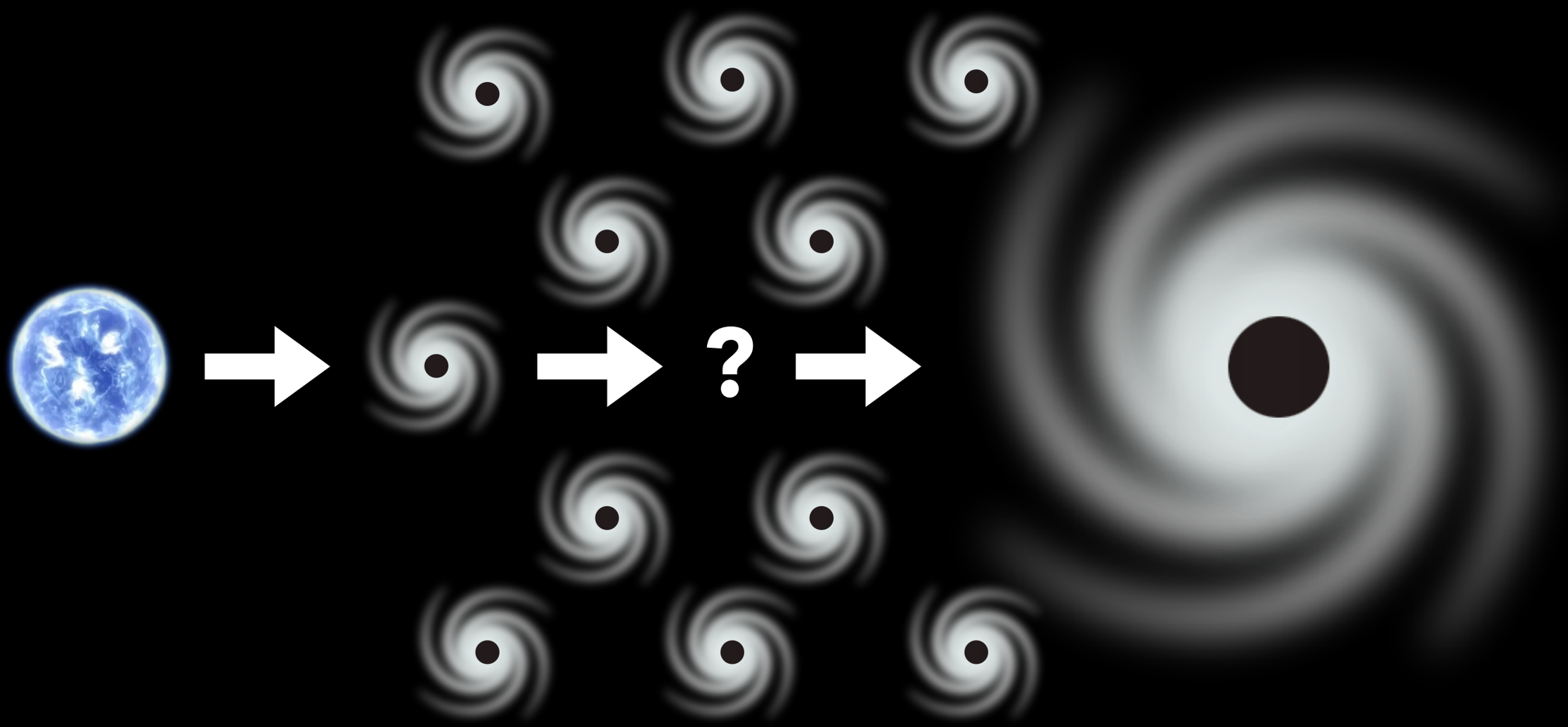
The fate of a star depends on its mass (size not to scale)

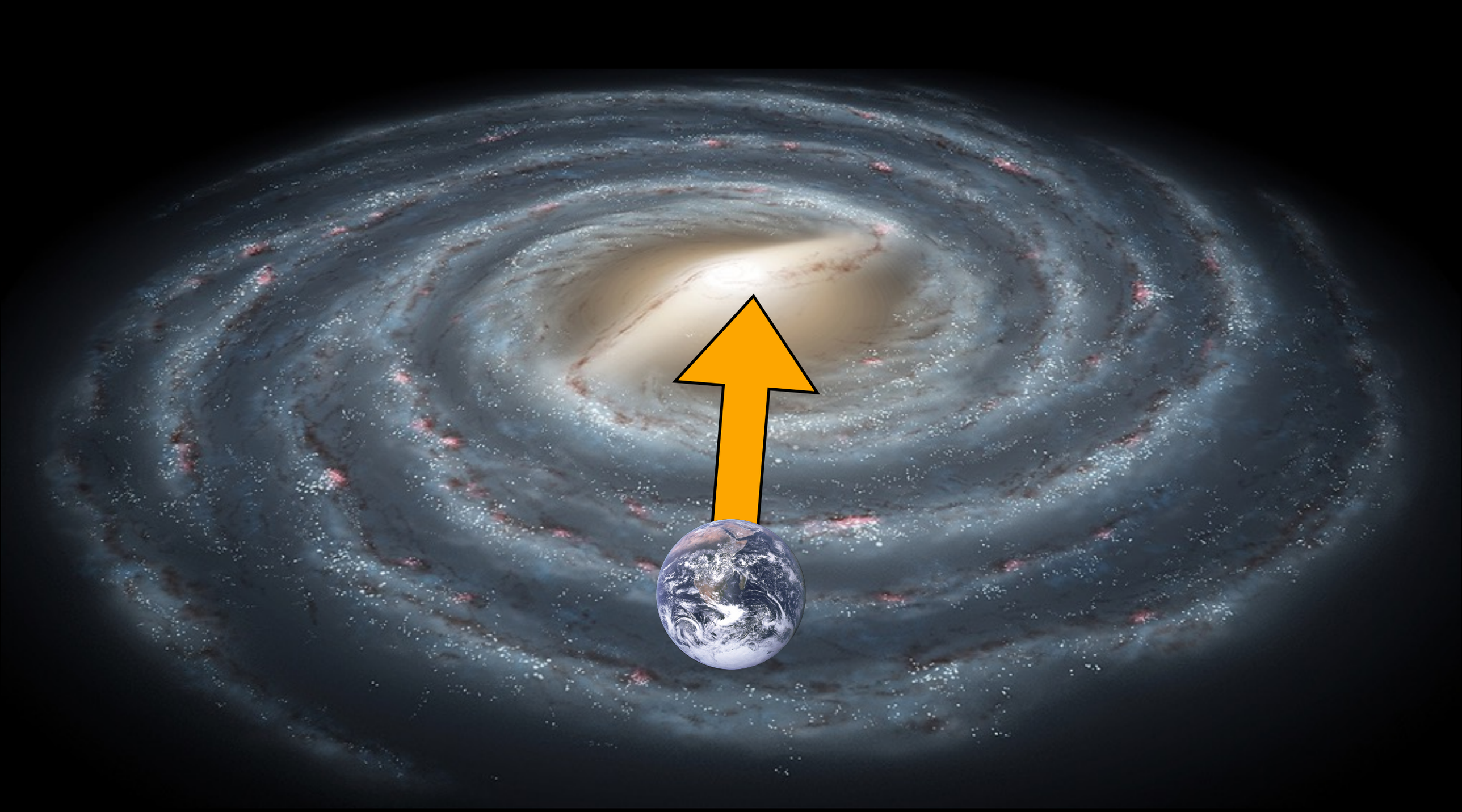
BIRTH OF A BLACK HOLE

BIRTH OF A BLACK HOLE

BLACK HOLE TYPES

- Stellar-mass: black holes with 3 to 20 times the mass of our own Sun
- Supermassive: black holes with millions to billions of times the mass of our own Sun





2002: The Milky Way's Lurking Monster

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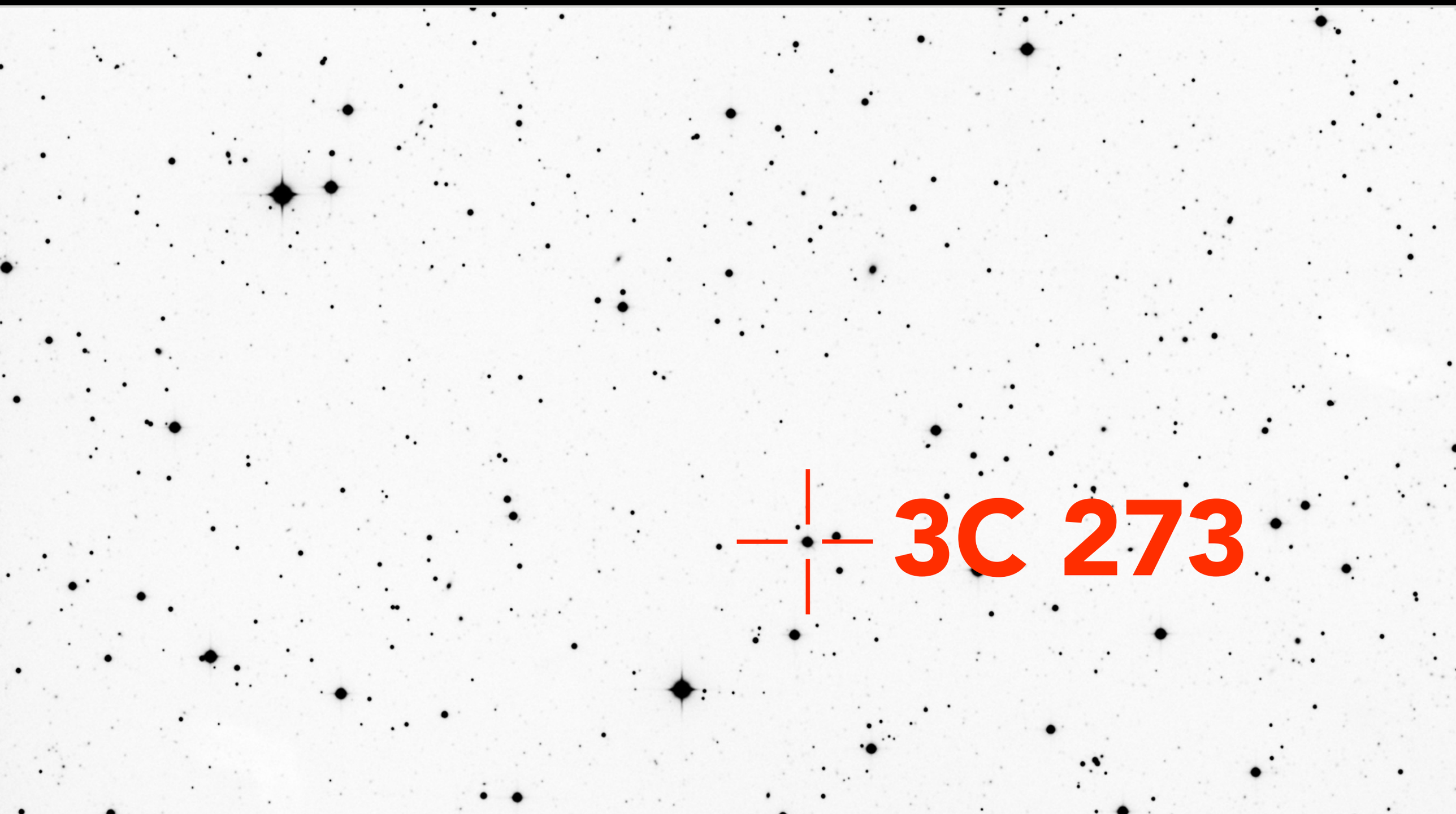
Black Holes

How do we find them?



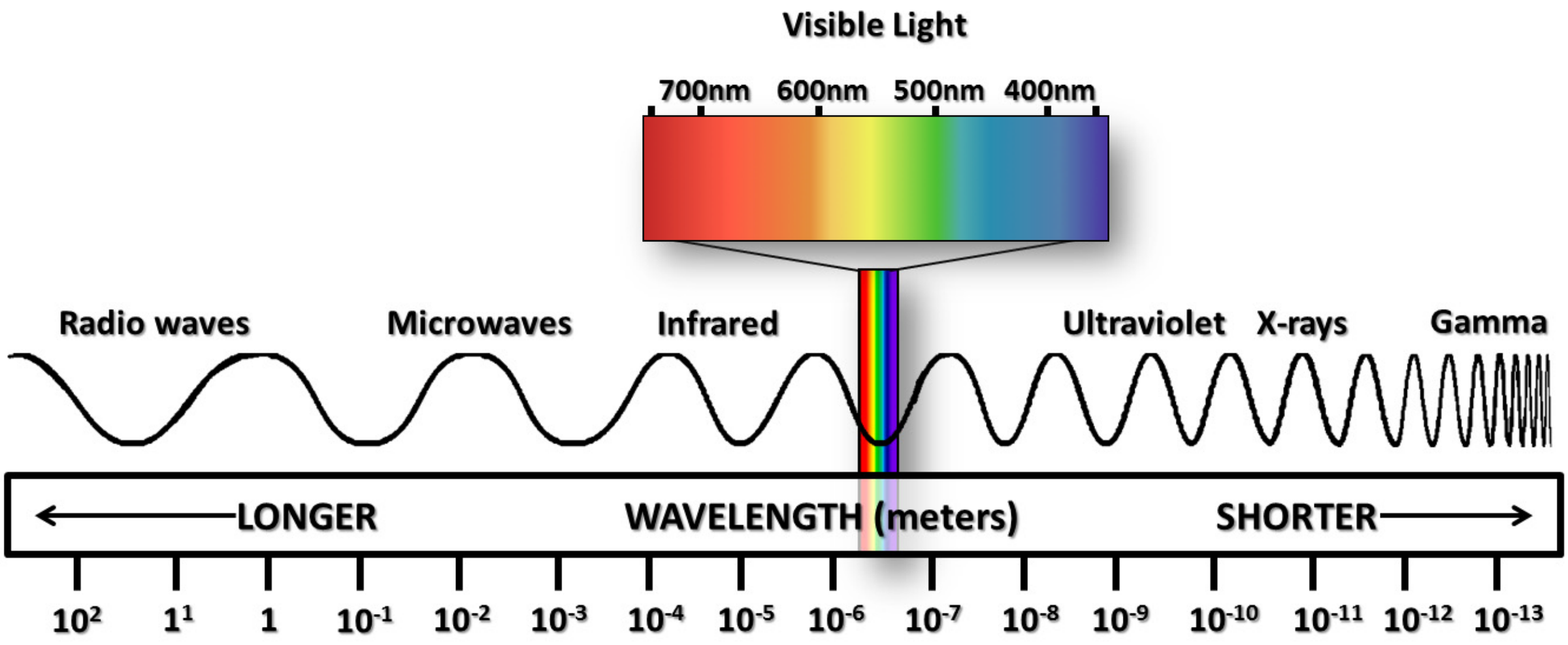
QUASAR 3C 273

- Discovered in 1959
- 273rd object in the 3rd Cambridge Radio Survey (3C 273)
- Classified as a Quasar or quasi-stellar radio source (looks like a star, but is not)
- Approximately two billion light years away (that's 2×10^{22} or 20,000,000,000,000,000,000,000 kilometres away)

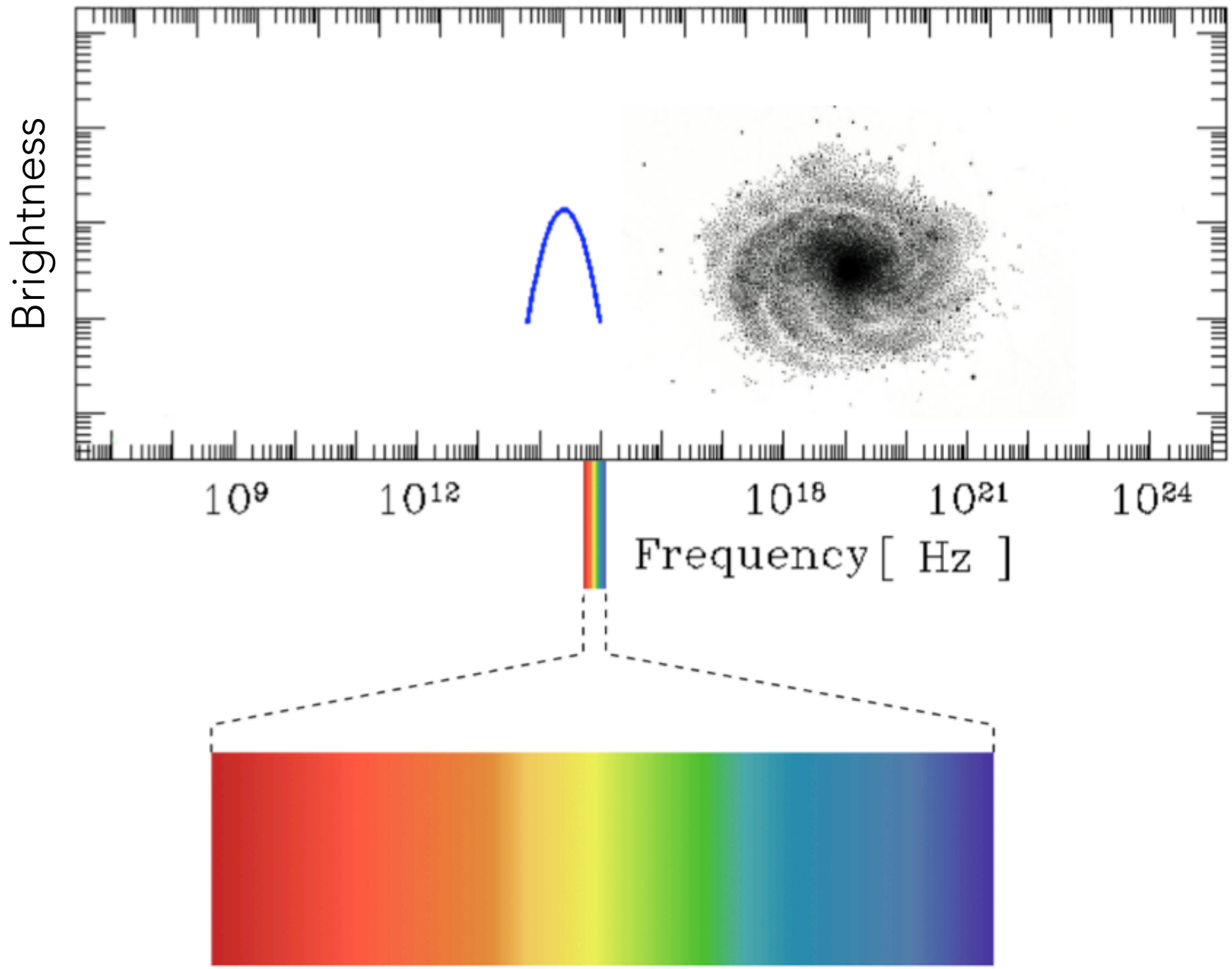
How Bright is it?

4 TRILLION TIMES BRIGHTER THAN THE SUN!

ELECTROMAGNETIC SPECTRUM

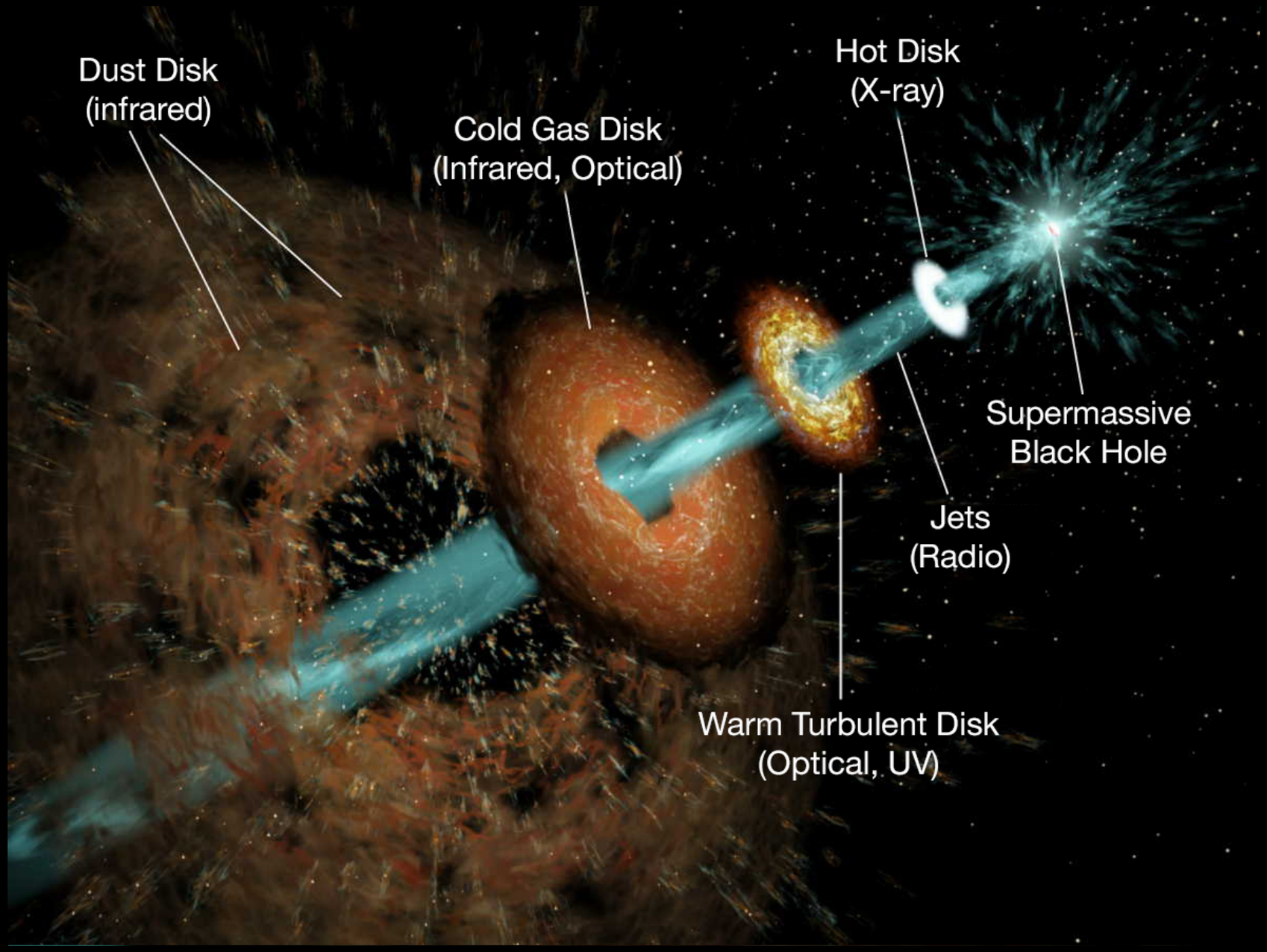


QUASAR 3C 273 SPECTRUM



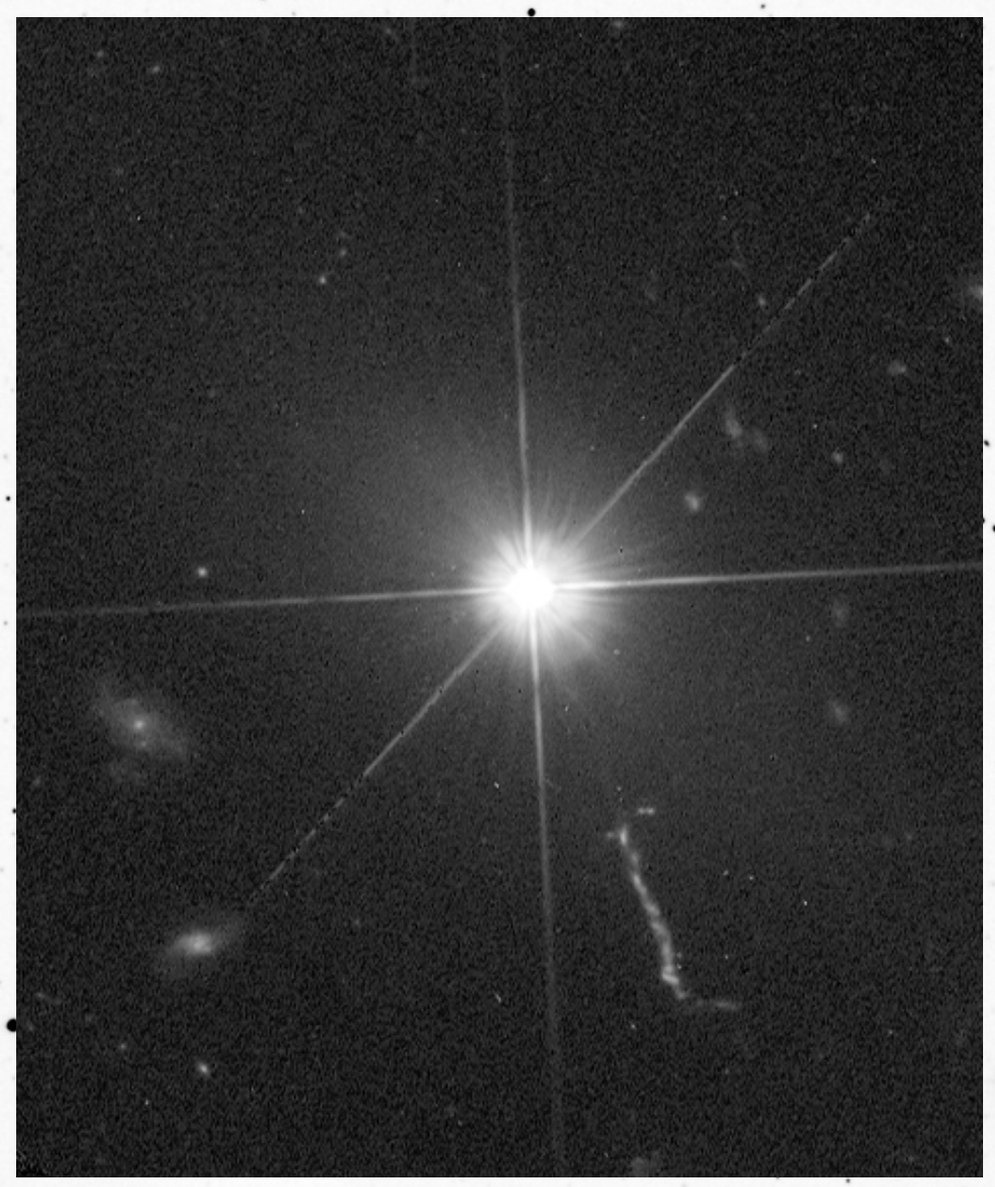
Black Holes

Where does the light come from?



- Gravity causes material to spiral inward towards the black hole
- Frictional forces compress and raise the temperature of the material causing the emission of light ranging from X-rays to infrared
- Particles accelerated to speeds approaching that of light and emerge from the poles as radio jets

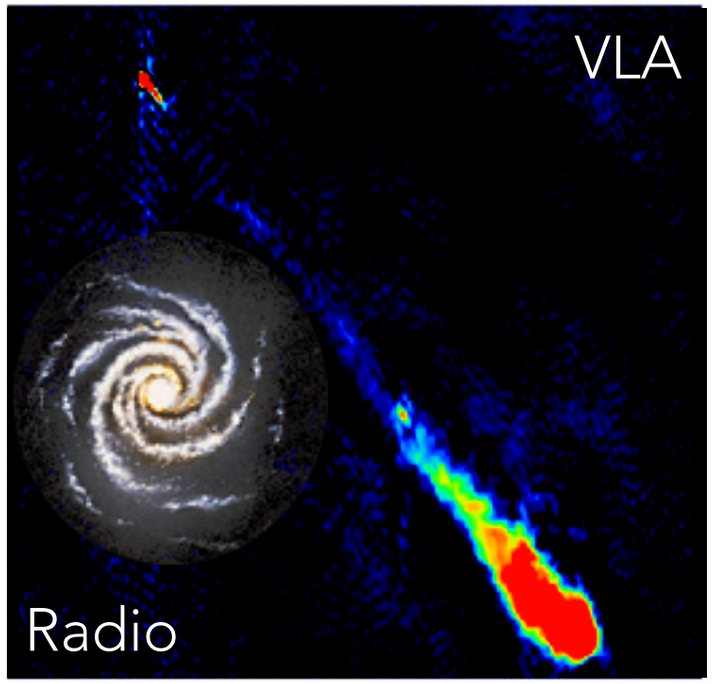
QUASAR 3C 273

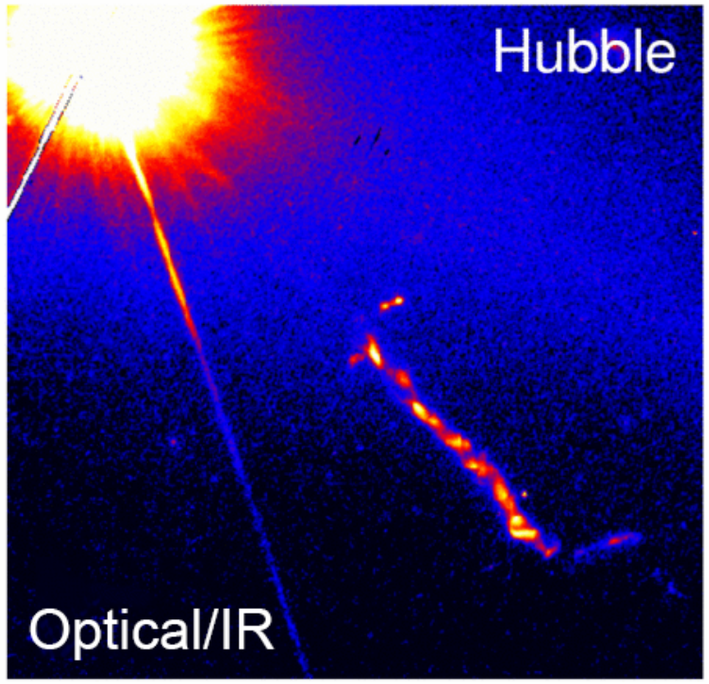


3C 348 in the constellation Hercules

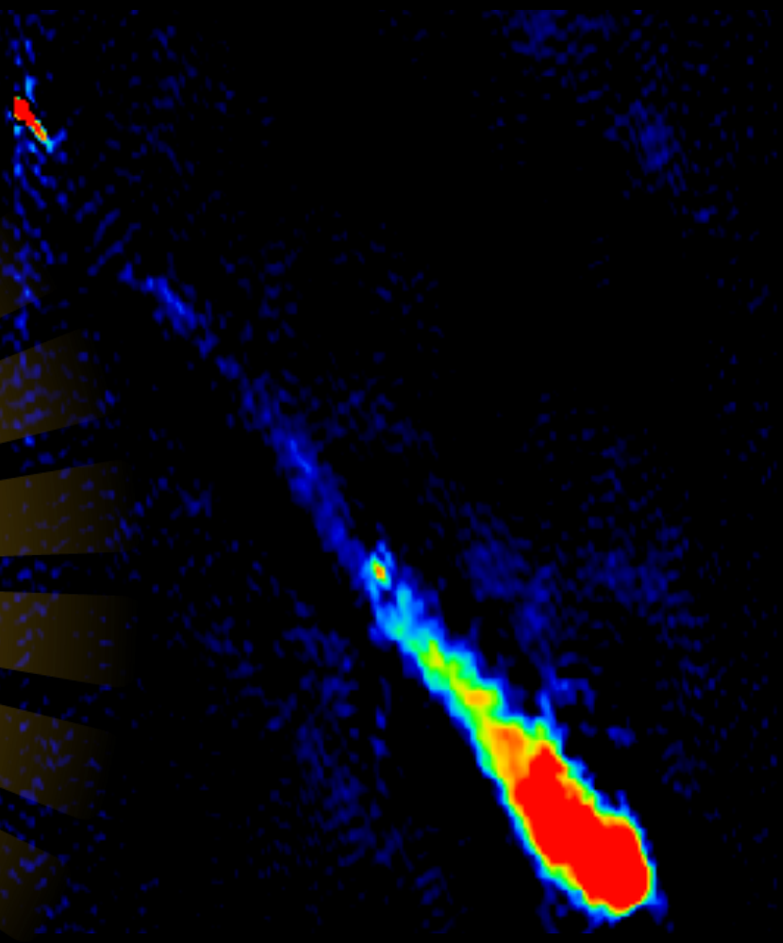
QUASAR 3C 273 RADIO JET

~2 x longer than distance across Milky Way



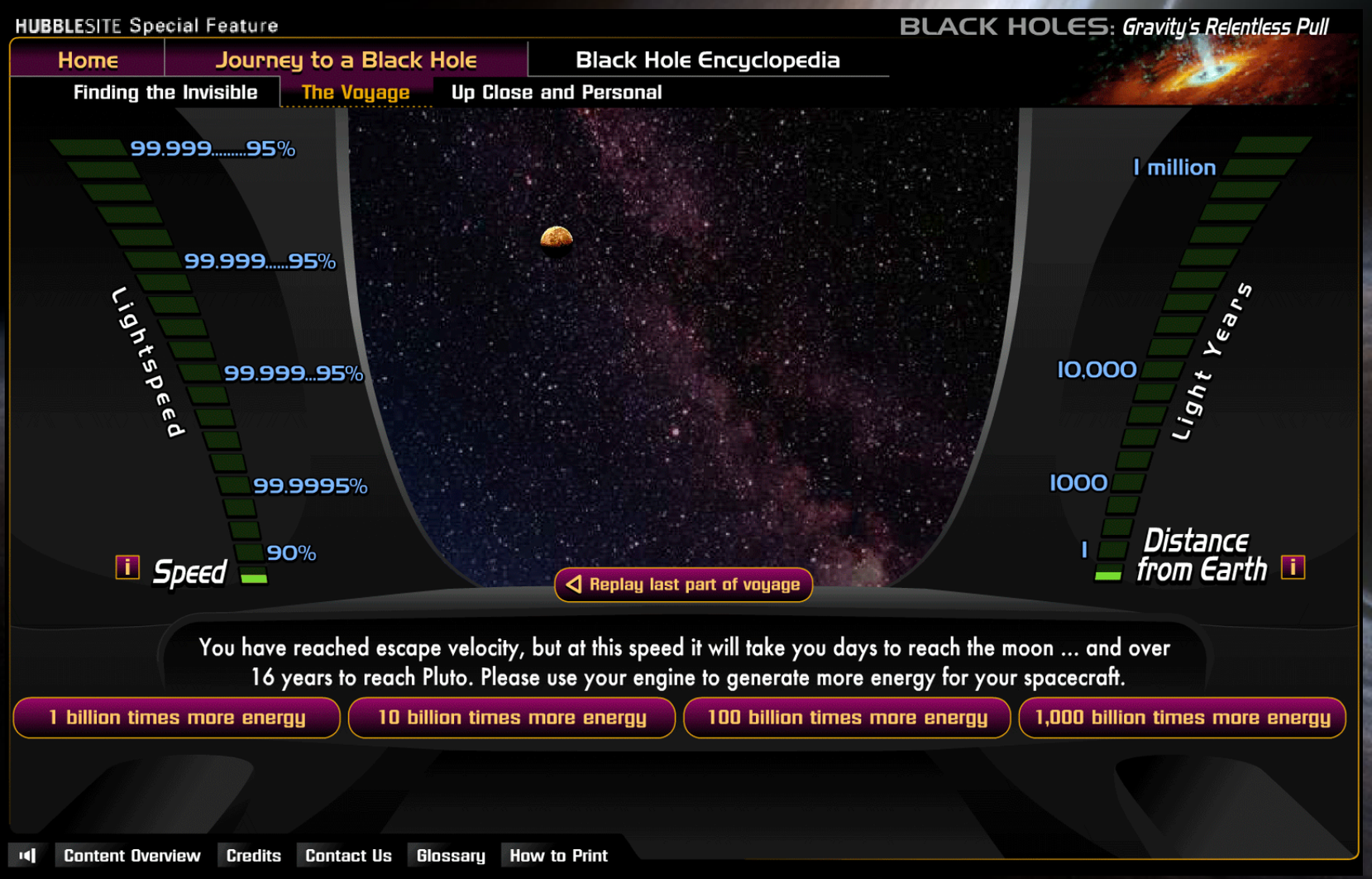


CAN BLACK HOLES SHINE?



4 TRILLION
TIMES BRIGHTER
THAN THE SUN!

Want to learn more?



QR CODE SCAN ME!

http://hubblesite.org

HUBBLESITE

WHAT IS SPAGHETTIFICATION?

BLACK HOLE

AS AN OBJECT FALLS INTO A BLACK HOLE AND APPROACHES THE SINGULARITY AT THE CENTRE, IT WILL BECOME STRETCHED OUT OR "SPAGHETTIFIED" DUE TO THE INCREASING DIFFERENTIAL IN GRAVITATIONAL ATTRACTION ON DIFFERENT PARTS OF IT.